Mathematics 20D Syllabus (revised December 2017)

Based on *Fundamentals of Differential Equations* (9th edition) by Nagle, et al.

The following syllabus requires 25 lectures of the 28 to 30 lectures available in a typical quarter. Time permitting, some topics can be expanded, or additional topics can be covered from the list provided at the bottom of this page.

Note on Chapter 9: Math 20D does not have a linear algebra prerequisite, but it does include solving systems of linear first order differential equations using eigenvalue/eigenvector methods (Chapter 9). Since it cannot be assumed that students have any background in linear algebra, it is standard to confine the discussion to 2×2 and (possibly) 3×3 matrices.

Lecture	Section	Topic
1	1.1	Background
	1.2	Solutions and Initial Value Problems
2	1.3	Direction Fields
3	2.2	Separable Equations
4	2.3	Linear Equations
5	2.4	Exact Equations
6	4.2	Homogeneous Linear Equations: The General Solution
7	4.3	Auxiliary Equations with Complex Roots
8	4.4	Nonhomogeneous Equations: The Method of Undetermined Coefficients
9	4.5	The Superposition Principle and Undetermined Coefficients Revisited
10	4.6	Variation of Parameters
11	4.7	Variable-Coefficient Equations
12	9.1	Introduction
	9.3	Review of Matrices and Vectors
13	9.4	Linear Systems in Normal Form
14	9.5	Homogeneous Linear Systems with Constant Coefficients
15	9.6	Complex Eigenvalues
16	9.7	Nonhomogeneous Linear Systems
17	9.8	The Matrix Exponential Function
18	7.2	Definition of the Laplace Transform
19	7.3	Properties of the Laplace Transform
20	7.4	Inverse Laplace Transform
21	7.5	Solving Initial Value Problems
22	7.6	Transforms of Discontinuous Functions
23	7.9	Impulses and the Dirac Delta Function
24	8.2	Power Series and Analytic Functions
25	8.3	Power Series Solutions to Linear Differential Equations

Additional Topics (Time Permitting)

Section	Topic
2.5	Special Integrating Factors
4.8	Qualitative Considerations for Variable-Coefficient and Nonlinear Equations
4.9	A Closer Look at Free Mechanical Vibrations
7.7	Transforms of Periodic and Power Functions
7.8	Convolutions

Mathematics 20D Syllabus (revised December 2017)

MATLAB Portion of Math 20D Syllabus

Math 20D has lectures and recitation sections like all other big classes. Distinctive in Math 20D (and Math 18) is that regular Math 20D homework is accompanied by homework in MATLAB, and typically there is a simple quiz on MATLAB which is provided through a department testing procedure (so the instructor does not need to do much work). Most instructors count the MATLAB homework 4% of the grade and the MATLAB "final quiz" 6% of the grade for a total of 10%.

MATLAB homework assignments can be found online at www.math.ucsd.edu/~math20d

1. Introduction to MATLAB (do in week 2)

2. Visualizing Solutions to ODEs using DFIELD and PPLANE (start your direction fields lectures first)

3. Numerical Methods with First-Order Equations (do anytime you like)

4. Systems of ODEs (do most of your ODE systems lectures first)

The department provides tutors for the MATLAB Assignments, a MATLAB final quiz, and grading of the MATLAB portion of the course. The intention is that the Math 20D professor need not worry about MATLAB instruction at all or even worry much about logistics. We suggest the instructor announce (post on web):

1. The webpage for the MATLAB assignments is www.math.ucsd.edu/~math20d

2. MATLAB tutoring is available in the basement B432. It starts in week 2, students can just walk in (schedule to be posted on the web)

3. The dates you want MATLAB homework assignments to be due (typically to complement your class midterms and quizzes)

4. Where to turn homework in: the homework drop boxes in the basement of APM

5. Your grading policy

6. The week when you want your students to take the MATLAB final quiz (e.g. 9th week). MATLAB staff handles and posts schedule of times in that week.

Our MATLAB offering is run by a professor, whose role is to help you. You should always feel free to contact her/him and you will get an email from her/him a bit before your course starts. The department also employs a senior MATLAB TA.

An important feature of the MATLAB homework is that it fills gaps in the lectures:

1. Math 20D Applications are in the MATLAB assignments, which is pedagogically a natural place for them. Thus we expect that many of the application type word problems in Math 20D are in the MATLAB assignments.

2. Numerical ODE is not covered in lectures, but is MATLAB Assignment 3.

3. Systems of ODE are touched on in Assignment 2, which is before you hit them in lecture; hopefully this helps your class presentation.

Student feedback on this disjointness from the class has been surprisingly positive. We suggest you take a quick look at the MATLAB assignments online with an eye to how their math content supplements the course.